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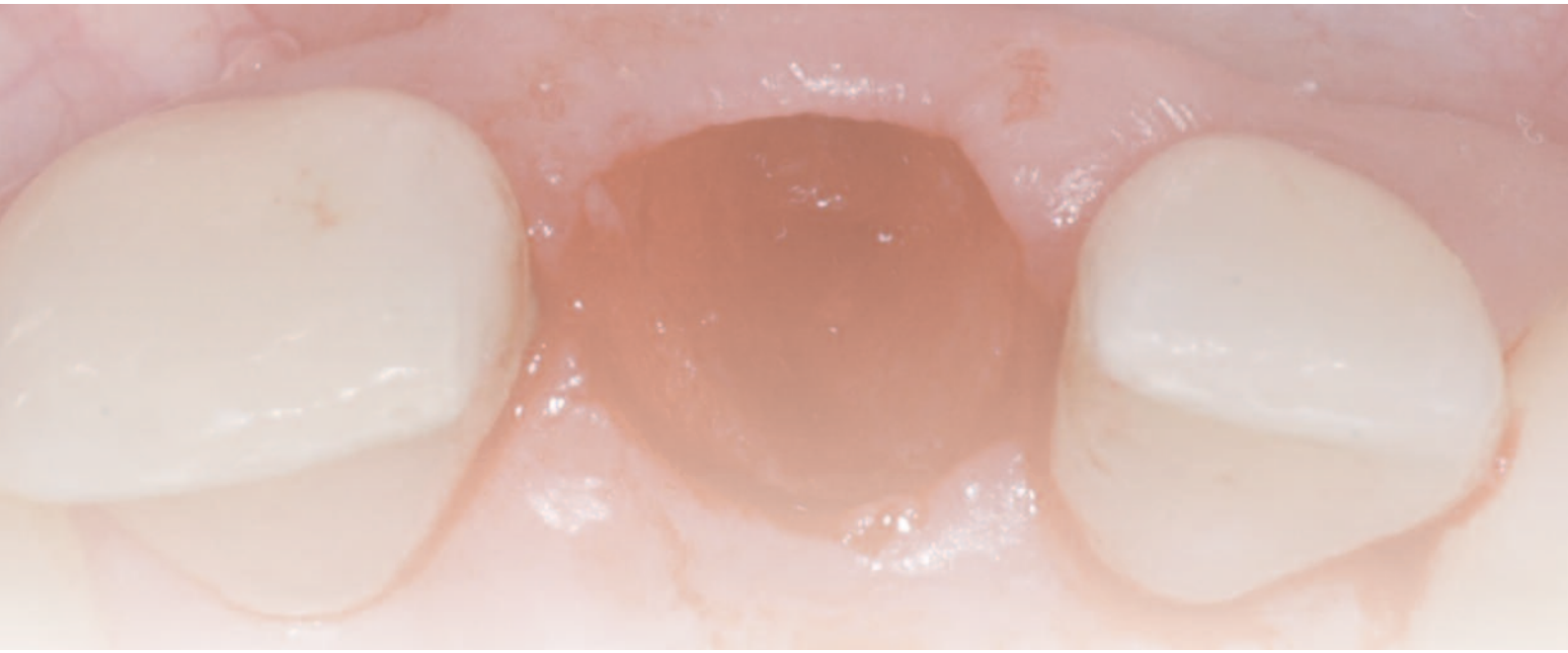

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Mastering aesthetics in post-extraction sites

Ronnie J. Goené, DMD and Alwin C.L. van Daelen, DMD

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aesthetics

Mastering aesthetics in post-extraction sites

Ronnie J. Goené, DMD† and Alwin C.L. van Daelen, DMD

Patients increasingly seek implant-supported restorations that can be delivered as quickly and non-invasively as possible. Many also prefer to avoid wearing a removable prosthesis after tooth extraction. Implants that are placed immediately in fresh extraction sockets and provisionalized immediately serve these goals and have high survival rates; however, questions have remained about the aesthetics achievable for such implants. This article reviews a protocol for achieving a high level of aesthetic success for implants placed in fresh anterior maxillary extraction sockets and immediately provisionalized. A clinical case presentation illustrating this approach is presented.

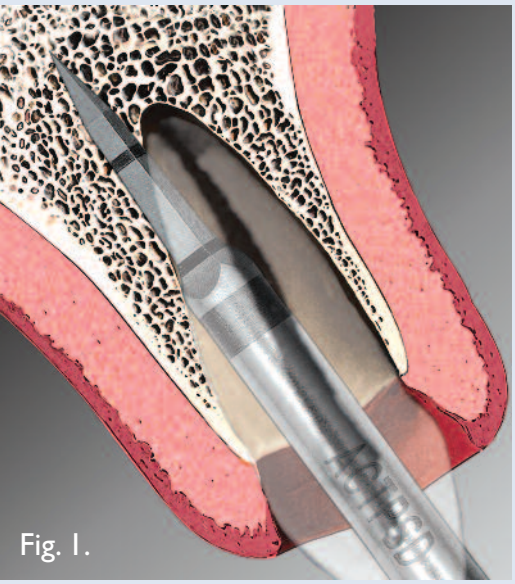
Key Words: Aesthetics, immediate implant placement, provisionalization, anterior, maxillary

Introduction

Tooth sockets develop when the teeth initially erupt. When a tooth is lost, the socket loses its function, and deterioration begins immediately. Coagulum forms within, eventually to be replaced by new woven bone. At the same time, cortical bone outside the socket resorbs, creating concavities and typically, attendant soft-tissue loss. In a human prospective study focusing on molars and premolars, Schropp et al[1] found that changes in ridge contours during the first 12 months post-extraction were predominantly horizontal and more pronounced buccally than lingually. The width of the ridge was reduced by 50%, on average, with two-thirds of that change occurring within the first three months of healing.

Studying dimensional changes after extraction of canine mandibular premolars in dogs, Araujo and Lindhe[2] concluded that substantial vertical reduction of the buccal crest occurred because the buccal bone wall is composed solely of bundle bone – the bone in which the Sharpey fibers attach. Bundle bone forms a functional unit with the periodontal ligament (PDL) and the root cementum. When the tooth root and its cement are extracted, the PDL is destroyed, along with the function of the bundle bone. The extent of the vertical change depends on the proportion of bundle bone in the most coronal portion of the socket wall; the thinner the wall, the greater the vertical bone loss.

When Januario et al[3] measured cone-beam CT scans of 250 patients, they found anterior maxillary facial plate thicknesses ranging from 0.3 to 1mm, with about 50% of the wall thicknesses less than .5mm. This suggests that for many patients, extraction of an anterior maxillary tooth will result in loss of the entire buccal plate, dramatically impacting the overall ridge contours.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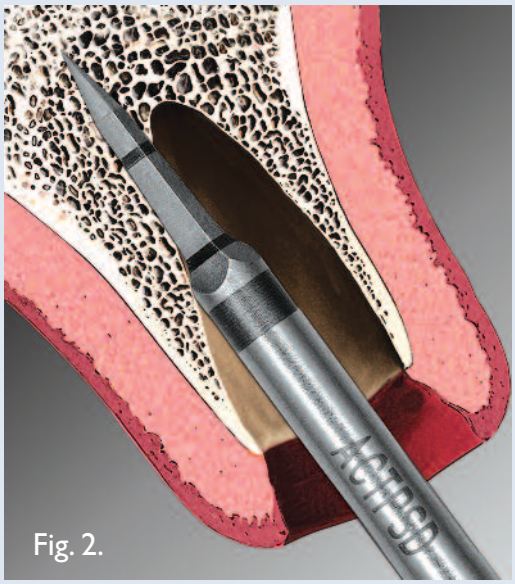
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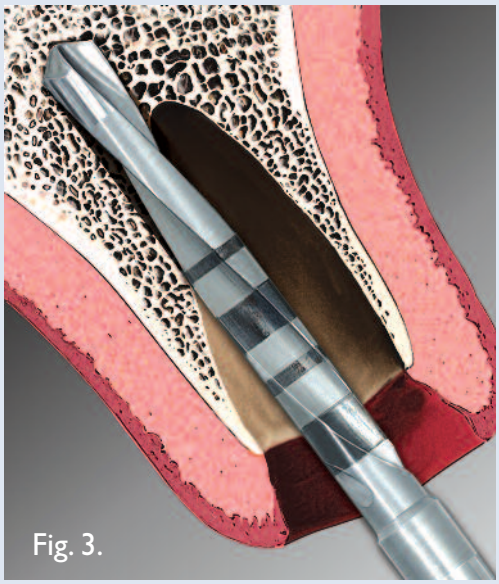
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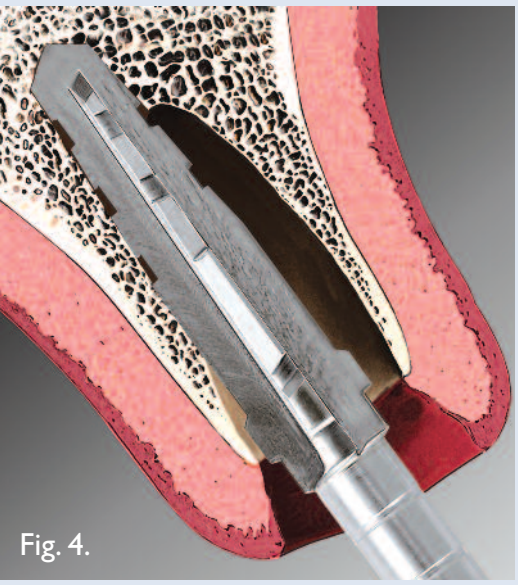
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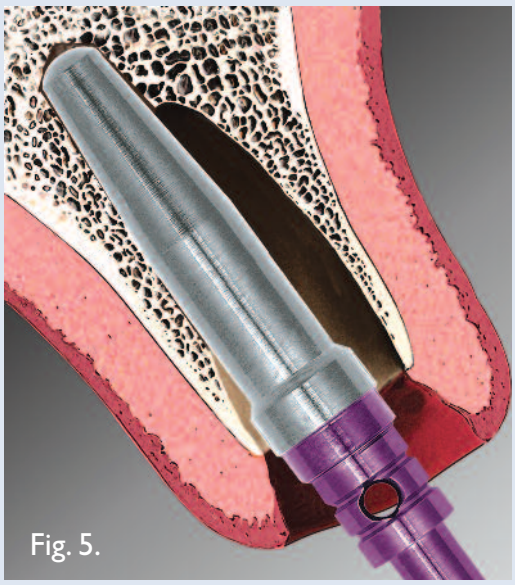
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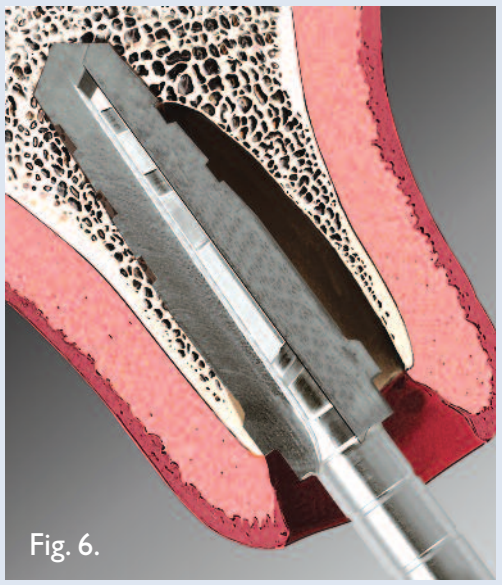
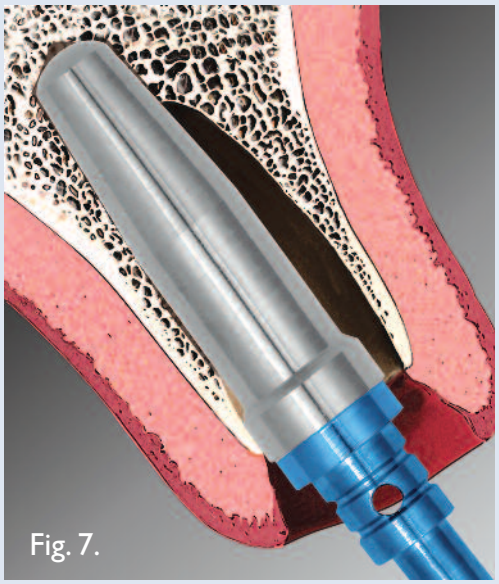


Fig. 6.

To reconstruct the original bony architecture, enabling it in turn to support the overlying soft-tissue drape, a number of surgical techniques have been developed. Augmentation can be accomplished using a variety of materials and may occur either before implant placement or simultaneously. However, the process of extracting a tooth, allowing the extraction site to heal, augmenting the site, and placing an implant can be significantly compressed if the implant is placed immediately after the tooth extraction. Although numerous studies have demonstrated survival rates for immediately placed implants that are comparable to those achievable with a delayed protocol,[4-13] a literature review and meta-analysis of the aesthetic outcomes of immediate placement found inconclusive evidence due to a lack of well-designed controlled clinical studies.[14]

The authors have developed a protocol for helping to ensure a high level of aesthetic success for immediately placed anterior maxillary implants. The protocol covers five key treatment phases: 1) preoperative analysis, 2) tooth extraction, 3) implant placement, 4) bone augmentation, and 5) prosthetic management.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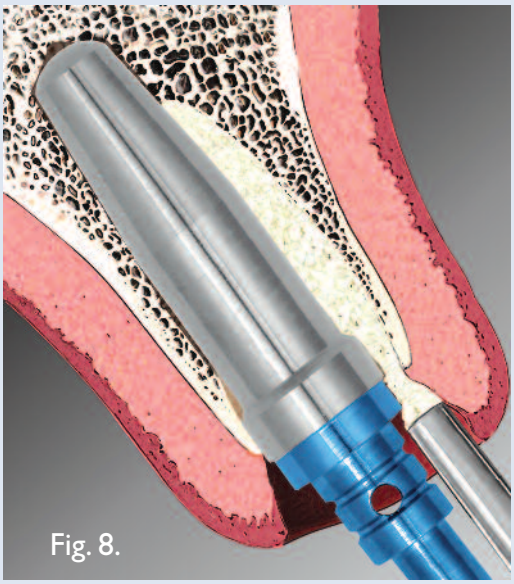
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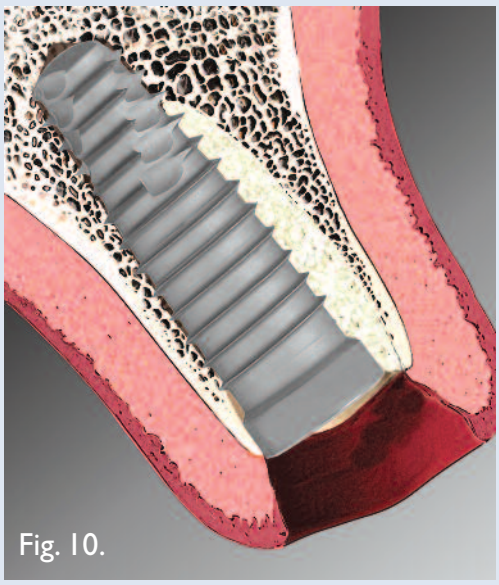
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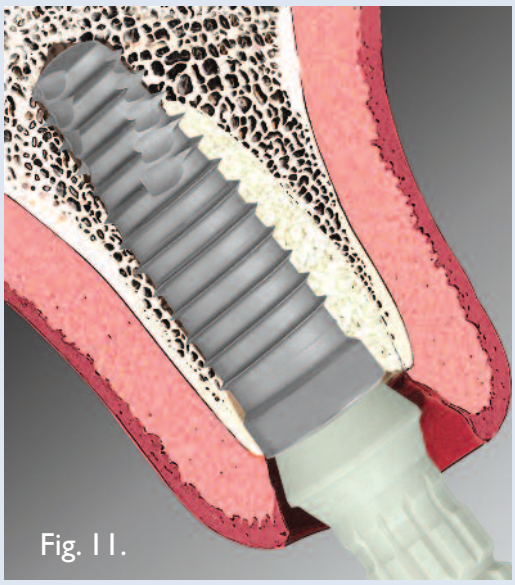


Fig. 11.

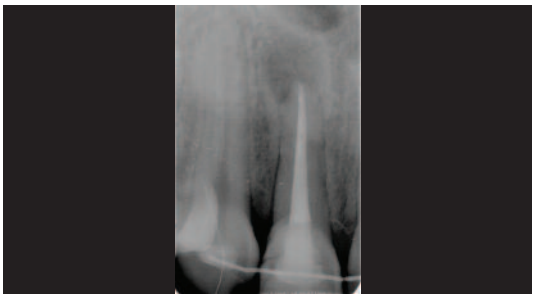

Fig. 12.

Preoperative Analysis

The presurgical presence of harmonious soft-tissue architecture is a prerequisite to achieving an aesthetic result for any immediately placed anterior maxillary implant. The facial contour of the alveolar crest should be convex, and the course of the gingival line should be nicely scalloped without abrupt changes in the tissue height. In general, the higher the scallop, the lower the chances for acceptable papillary regeneration. Thick, flat biotypes have a lower risk of recession than thin, scalloped ones. Moreover, a recent paper by Cook et al[15] provided the first clinical evidence that the thickness of the soft tissue correlates with a thicker buccal bone plate.

Another essential part of the preoperative analysis is bone sounding to determine the approximal bone height and the level of the facial bone wall midfacially at the zenith of the tooth to be extracted. If the distance from the contact point of the crown to the bone level at the adjacent teeth is less than, or equal to 5mm, excellent recovery of the papillae can be expected. However, a distance of greater

Fig. 13



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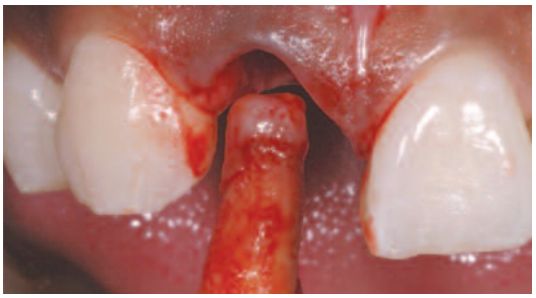

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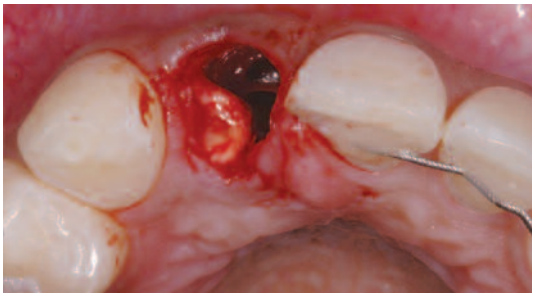
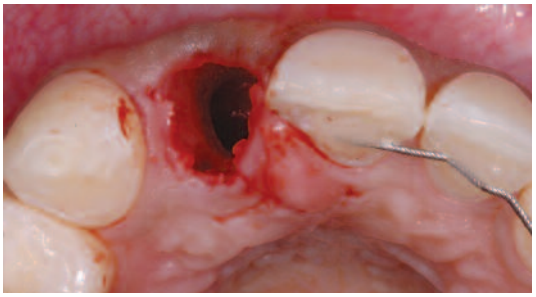


Fig. 18



than 5mm is likely to result in a black triangle.[16] The level of the bony wall midfacially at the zenith of the tooth to be extracted is another important measurement and should not exceed 3mm. If there is more than 3mm, more recession will most likely be the result. If this is the case, a proactive orthodontic extrusion or a delayed approach to implant placement may be the treatment of choice.

Tooth Extraction

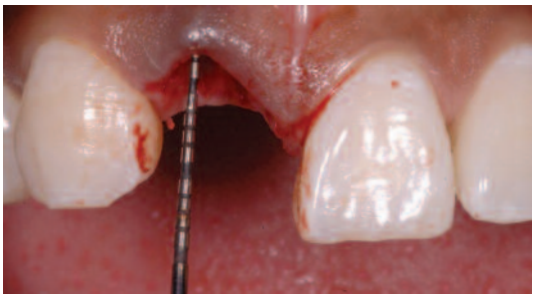
A flapless, atraumatic extraction technique is essential for any anterior maxillary tooth for which immediate implant placement is being considered. After the tooth has been removed, the integrity of the labial plate should be verified with a periodontal probe. If the plate is not intact, the implant should not be placed immediately but rather 4-6 months later,[17] and ridge preservation with a bone substitute and barrier membrane should instead be carried out.

Osteotomy Creation, Bone Augmentation, and Implant Placement

If the labial plate is intact, osteotomy preparation may proceed. The aim should be to redirect the osteotomy more palatally for better bone engagement of the implant and consequently better primary stability. This is accomplished as follows: First, a pointed starter drill is used to create a notch approximately 4mm away from the original apex up to the palatal wall (Figs. 1 and 2). A 2mm twist drill is then placed in the notch, advancing closely parallel to the palatal wall (Fig. 3). The osteotomy preparation is continued with a 3.25mm Quad Shaping Drill (QSD) (Fig. 4), followed by placement of a corresponding Depth/Direction Indicator (Fig. 5) to check the depth and horizontal positioning of the implant to be placed. If placing a 4mm diameter implant, preparation of the osteotomy continues with use of a 4mm QSD (Fig. 6) followed by a 4mm Depth/Direction Indicator (Fig. 7).

With the Depth/Direction Indicator in place, a mixture of autogenous bone (collected from the flutes of the Quad Shaping Drills) and a xenograft is placed into the void space in the extraction socket (Fig. 8). The Depth/Direction Indicator is then carefully removed (Fig. 9), and the implant is placed in the newly created osteotomy (Fig. 10). The

Fig. 19



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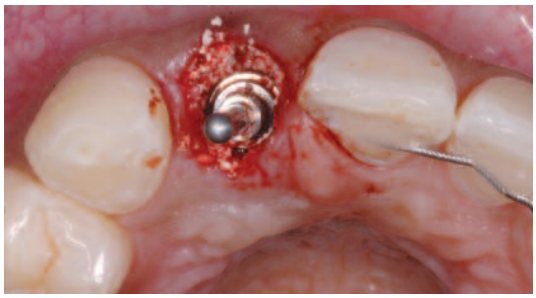


Fig. 21

Fig. 22

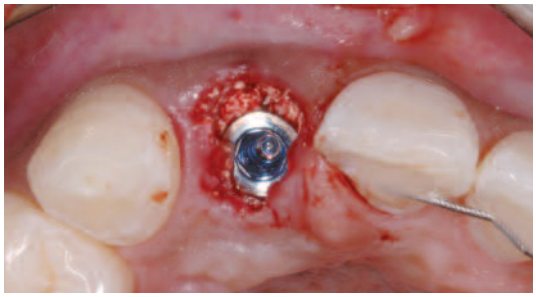


Fig. 23

Fig. 24

rationale for first placing the xenograft and then the implant instead of the other way around is that this prevents the stainless steel instruments from possibly damaging or contaminating the implant titanium oxide layer.

Prosthetic Management

A platform-switched provisional cylinder is then inserted into the implant and secured with a titanium abutment screw (Fig. 11). A customized provisional restoration, fabricated from a presurgical impression of the hopeless tooth, is mounted on the cylinder out of occlusion, with no centric contracts or lateral excursions (Fig. 12). While the provisional crown should mesially and distally mimic the normal emergence profile of the natural tooth being replaced, the buccal aspect should be deliberately undercontoured to avoid any displacement of the buccal soft tissue.

The following clinical case presentation illustrates the use of this protocol.

Clinical Case Presentation

The patient was a 19-year-old male whose right maxillary central and lateral incisors had been evulsed in a bicycle accident when he was eight. The central incisor was initially repositioned and the lateral incisor was left out. Several years later, the right maxillary canine was orthodontically moved. Although this successfully closed the diastema that had remained, eventual internal and external resorption of the central incisor made it unsalvageable (Fig. 13).

Comprehensive preoperative analysis showed the periodontal biotype to be thin, with pronounced gingival scalloping (Fig. 14). Sounding the bone level of the adjacent teeth with a periodontal probe revealed the contact point to be 5mm and the midfacial bone level at the zenith of the hopeless tooth to be 3mm (Fig. 15).

On the day of surgery, the central incisor was atraumatically extracted (Fig. 16); pronounced palatal root resorption was found. The socket was thoroughly cleaned, and an

Fig. 25

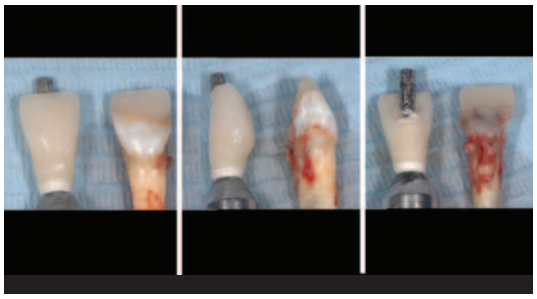
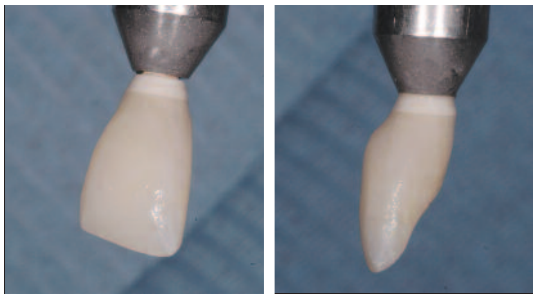


Fig. 26



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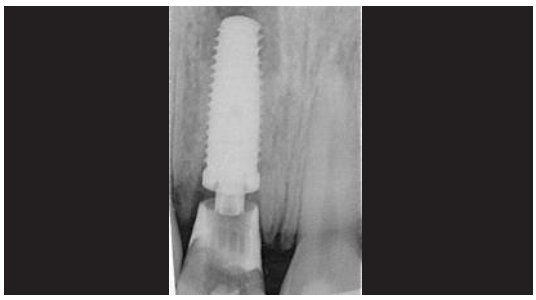

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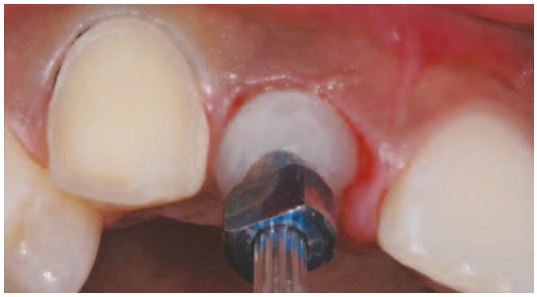


apical granuloma was debrided (Figs. 17 and 18). The labial plate was found to be intact (Fig. 19). An osteotomy was prepared closely parallel to the palatal wall of the socket, and the gap buccal to the Depth/Direction Indicator was filled with Endobon® Xenograft Granules (BIOMET ***3i***) (Fig. 20). The Depth/Direction Indicator was removed, and a 15mm long ***3i*** T3® Tapered Implant (platform switched) was placed (Figs. 21 and 22).

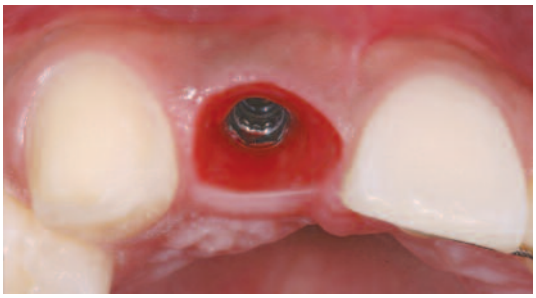
Testing with a High Torque Indicating Ratchet Wrench found the primary stability to be greater than 35Ncm. To protect the graft particles from being expelled, a collagen plug was placed over them, and a temporary healing abutment was screwed into the implant during the chairside fabrication of the provisional crown on a screw-retained PreFormance® Temporary Cylinder (Figs. 23 and 24). Although every effort was made to duplicate the extracted tooth, the buccal submucosal section was deliberately undercontoured in order to prevent recession (Figs. 25 and 26).

The healing abutment was removed, and the provisional crown was screwed into the implant (Fig. 27). A periapical radiograph was taken (Fig. 28), and the patient was dismissed with instructions to rinse twice daily with chlorhexidine.

At the two-week follow-up appointment, excellent soft-tissue healing was evident (Fig. 29). The patient returned in four months. Healing was uneventful. The provisional crown was replaced by a sandblasted impression coping, and flowable composite was added to duplicate the exact tissue contour. At this same appointment, the canine was prepared for a porcelain veneer, and a composite facing was temporarily secured with a spot-etch technique. The custom impression coping was mounted on the implant (Fig. 30), and the seating was confirmed radiographically (Fig. 31). The impression was poured, and a soft-tissue model that exactly replicated the mucosal contours was fabricated and sent to the BellaTek® Production Center (BIOMET ***3i***, Valencia, Spain).

Fig. 31

Fig. 32



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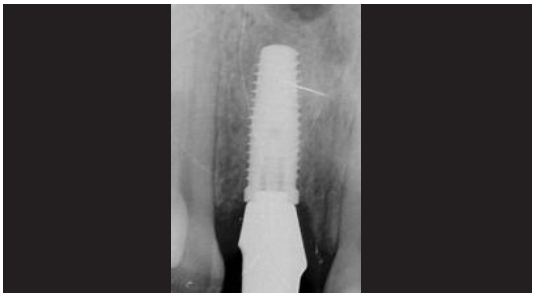

Fig. 36

Two weeks later, the provisional crown was removed (Fig. 32), and a BellaTek Abutment in Zirconia was positioned with the aid of an abutment verification index (Fig. 33) and tightened to 20Ncm of torque (Fig. 34). A radiograph confirmed proper seating (Fig. 35), and the definitive implant-supported restoration and porcelain veneer on the canine were delivered (Fig. 36).

Discussion

The importance of proper three-dimensional positioning of immediately placed dental implants has been clearly demonstrated. When Evans and Chen[18] studied the visible length of crowns placed on 42 immediately placed single-tooth implants, they found a highly significant change in crown height due to marginal tissue recession of 0.9 (+/- 0.78 mm). While the difference in outcomes between patients with thin and thick biotypes was not statistically significant, implants positioned buccally showed three times more recession than ones with a lingual shoulder position, with the difference being statistically significant.

The protocol suggested by the present authors to achieve a more palatal positioning is intended to eliminate this negative influence on soft-tissue levels. Use of the Quad Shaping Drills and Depth/Direction Indicators of the ***3i*** T3® Tapered Implant System further helps to achieve precise horizontal and vertical implant positioning. Furthermore, this implant design incorporates additional macrogeometric elements that may enhance primary stability, including tall, thin threads that penetrate laterally into the bone for secure long-term engagement.

The mere placement of an implant into a fresh extraction socket cannot prevent crestal remodeling. However, a recent study by Araujo et al[19] suggests that filling the void between the extraction socket wall and the implant with a mineralized collagen bone substitute, as recommended in the present protocol, modified the process of hard-tissue healing, provided additional amounts of hard tissue at the entrance of the previous socket, and improved the level of marginal bone-to-implant contact.

Clinical Relevance

Placement of implants into fresh extraction sites followed by immediate provisional restoration results in reproducible osseointegration and implant-survival rates that do not differ substantially from those achieved with traditional protocols.[4-13] However, achieving excellent aesthetic results after immediate placement and provisionalization, especially in maxillary midfacial sites, can be challenging. This article has outlined a protocol for enhancing the aesthetic results of single crowns supported by implants placed immediate after extraction. Proper patient selection, atraumatic tooth extraction, palatal implant placement coupled with bone augmentation, and careful prosthetic management are all important components of this protocol.

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††Mr. Suttin and Mr. Towse contributed to the above research while employed by BIOMET *3i*.

*0.37mm bone recession not typical of all cases.
**Seal integrity test was performed by BIOMET *3i* July 2011 - June 2012. In order to test the implant systems, a dynamic-loading leakage test was developed and executed. The test set-up was adapted from ISO14801, Dentistry - Implants - Dynamic Fatigue Test for Endosseous Dental Implants. Five samples each of the BIOMET *3i* and three competitive implant systems were evaluated. Bench test results are not necessarily indicative of clinical performance.

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